

Atty. Dkt. No. 039153-0472 (G1177)

REMARKS

Applicant respectfully requests reconsideration of the present application in view of the foregoing amendments and in view of the reasons that follow.

In the specification, paragraph 1 has been amended to update the Cross Reference to Related Application. No new matter is added.

Claims 1, 4, 10, 12, 15 and 17 are currently being amended.

This amendment adds, changes and/or deletes claims in this application. A detailed listing of all claims that are, or were, in the application, irrespective of whether the claim(s) remain under examination in the application, is presented, with an appropriate defined status identifier. After amending the claims as set forth above, claims 1-20 remain pending in this application.

In paragraphs 1 and 2 of the Office Action, claims 1-20 are rejected under 35 U.S.C. § 112, first paragraph. Applicants have amended independent claims 1, 10 and 15 in accordance with the Examiner's comments. Accordingly, withdrawal of the rejection of claims 1-20 is respectfully requested. No new matter is added in the amendments to claims 1, 10 and 15 to overcome the rejection under 35 U.S.C. § 112, first paragraph.

In paragraphs 3-4 of the Office Action, claims 1-20 are rejected under 35 U.S.C. § 103 as being unpatentable over U.S. Patent No. 6,268,291 (Andricacos) in view of U.S. Patent No. 6,426,289 (Farrar). The Examiner states:

Andricacos et al. teaches forming a barrier material layer along lateral side walls and a bottom of a via, the via electrically connecting a first conductive layer and a second conductive layer (Fig. 2, 4B, 5B, 6, col. 8, lines 48-60, col. 10, lines 13-20, 35-40). Andricacos et al. discloses implanting a metal into the barrier material layer, the implanted metal making the barrier material layer more resistant to copper diffusion (col. 5, lines 60-65, col. 6, lines 45-67, col. 8, lines 15-20, col. 10, lines 33-40, 48-55, 60-65). Andricacos et al. shows the barrier layer being tantalum and implanting tin (Sn) (heavy metal) (col. 10, lines 52-55, 62-65).

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In addition, Andricacos et al. shows the implanted metal forms an intermetallic with the second conductive layer (copper) (col. 13, lines 5-10). Andricacos et al. teaches providing a copper layer over an integrated circuit substrate, providing a barrier material layer at a bottom and sides of a via positioned over the copper layer, implanting a low dose metal species into the barrier material layer at an angle of zero degrees (Fig. 2, 4b, 6, col. 8, lines 48-65).

Applicants respectfully traverse the rejection. Andricacos and Farrar are referred to below as the cited art.

To advance prosecution, Applicants have amended independent claims 1, 10 and 15 to recite the use of a tilt angle implant. The tilt angle is recited as being between one and ten degrees. No new matter is added in the amendment.

The advantage of using a tilt angle implant is discussed in the present application. For example, the present application states:

Referring now to Figure 6, barrier layer 440 can also receive an implant 600 at a tilted angle. The implant of tilt can be one to ten degrees with respect to bottom 444 and via section 430. Implant 60 can be metal, which upon implant with barrier layer 440 can make barrier layer 440 amorphous and more resistance to copper (Cu) diffusion. Due to the tilted angle, barrier layer 440 at side walls 448 of via section 420 are made amorphous and resistant to copper diffusion.

See present application, paragraph 30. The cited art does not show or describe or suggest a tilt angle implant.

The Examiner admits that Andricacos only shows a zero degree implant angle. Andricacos does not mention a tilt angle with respect to the bottom of the via. Similarly, Farrar does not appear to disclose a tilt angle implant. Accordingly, it is respectfully submitted that independent claim 1 and its dependent claims 2-9, independent claim 10 and its dependent claims 11-14, and independent claim 15 and its dependent claims 16-20 are patentable over the cited art.

Dependent claims 12 and 17 have been amended for clarity. No new matter is added.

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Applicant believes that the present application is now in condition for allowance. Favorable reconsideration of the application as amended is respectfully requested.

The Examiner is invited to contact the undersigned by telephone if it is felt that a telephone interview would advance the prosecution of the present application.

The Commissioner is hereby authorized to charge any additional fees which may be required regarding this application under 37 C.F.R. §§ 1.16-1.17, or credit any overpayment, to Deposit Account No. 06-1447. Should no proper payment be enclosed herewith, as by a check being in the wrong amount, unsigned, post-dated, otherwise improper or informal or even entirely missing, the Commissioner is authorized to charge the unpaid amount to Deposit Account No. 06-1447. If any extensions of time are needed for timely acceptance of papers submitted herewith, Applicant hereby petitions for such extension under 37 C.F.R. §1.136 and authorizes payment of any such extensions fees to Deposit Account No. 06-1447.

Respectfully submitted,

Date 9-8-03

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